Figure 1. A) A representation of the composite detector material responding during an analyte exposure. B) A representation of how data are converted into response patterns.

Concentration (molar ppm in vapor)

10^6 — 100% RH
10^5 — 10% RH
10^4 — 1% RH
10^3 — 1000 ppm
10^2 — 100 ppm
10^1 — 10 ppm
10^0 — 1 ppm
10^{-1} — 100 ppb
10^{-2} — 10 ppb
10^{-3} — 1 ppb
10^{-4} — 100 ppt
10^{-5} — 10 ppt
10^{-6} — 1 ppt

ethylene oxide
acrylonitrile
ammonia
methyl mercaptan
H_2S
SO_2
nitric acid
hydrazine
formaldehyde
chlorine
nitrogen dioxide
allyl alcohol
toluene-diisocyanate (2,4)
arsine
sulfuric acid
parathion
acrolein
GB
GA
GD
HN-3
VX
L   HD

Minimum detectable level for sensors in C320 (estimate)

A
B

10^5 10^4 10^3 10^2 10^1 10^0 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}

Saturated vapor pressure at 25°C (mm Hg)

FIG. 2. Points use concentrations of Immediately Dangerous to Life and Health (IDLH) levels. Chemical warfare agents (red) and toxic industrial chemicals (blue) are shown. Chemicals with points above the region for the minimum detectable level have high probability of being detected by the sensor array in the Cyranose 320 at IDLH levels. Chemicals having points within the region have a moderate probability of being detected at IDLH levels. Chemicals having points below the region have a low probability of being detected at IDLH levels.
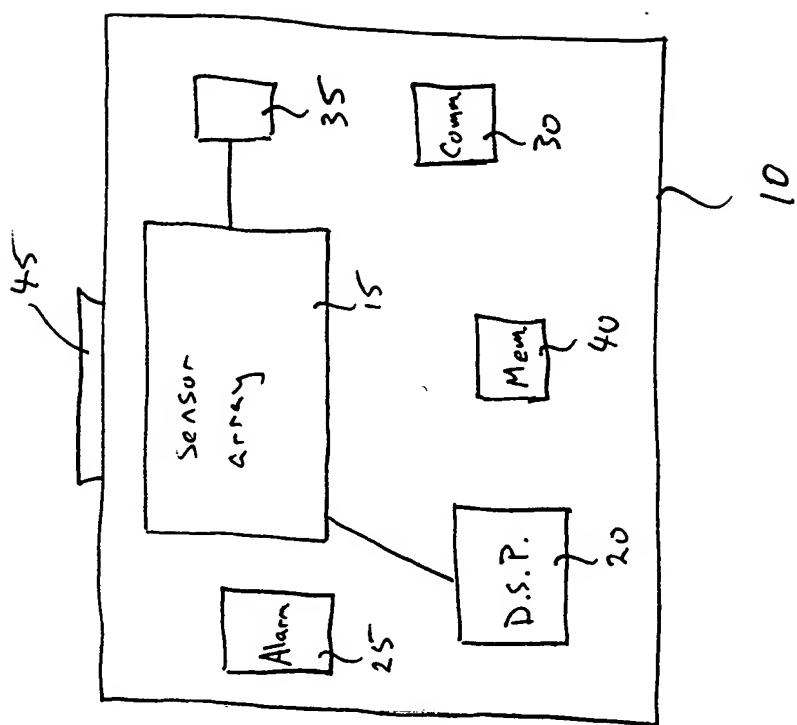
Figure 3a
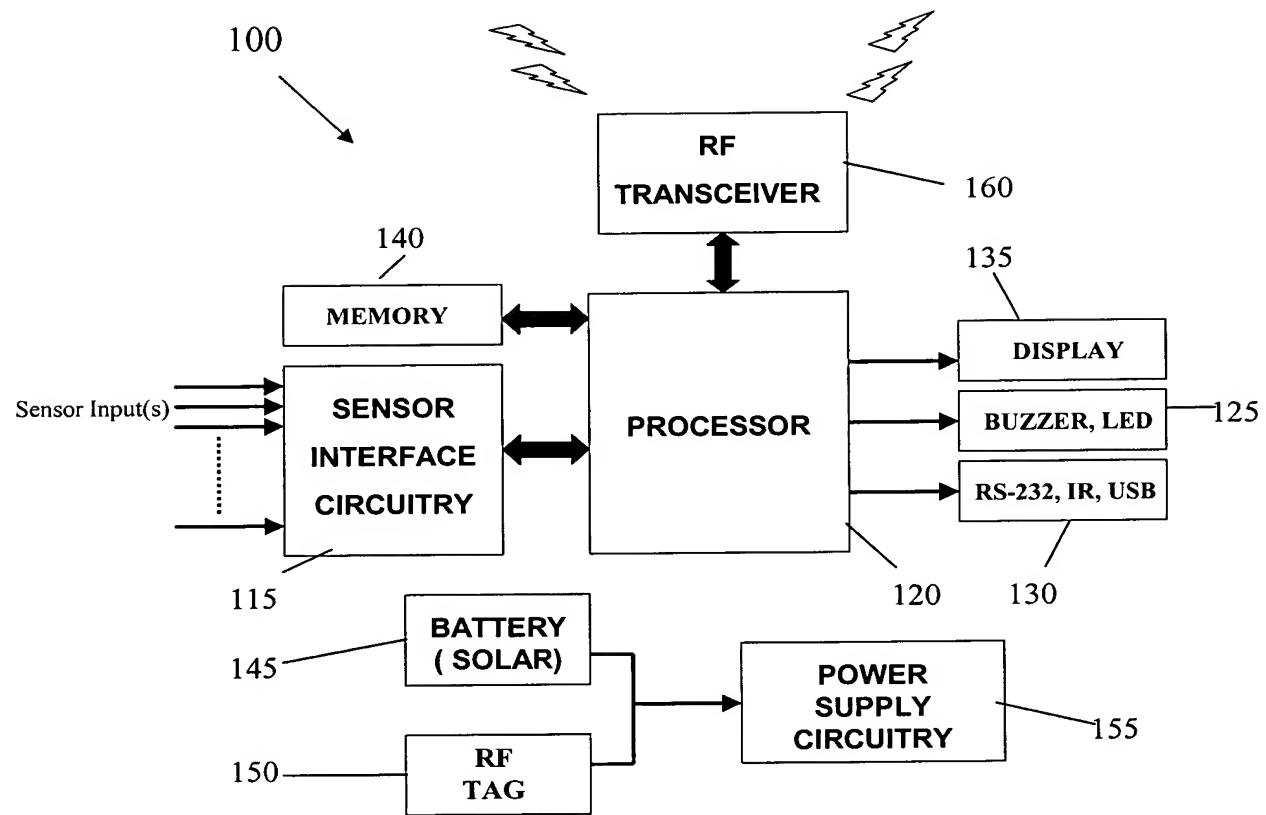
FIG.3b
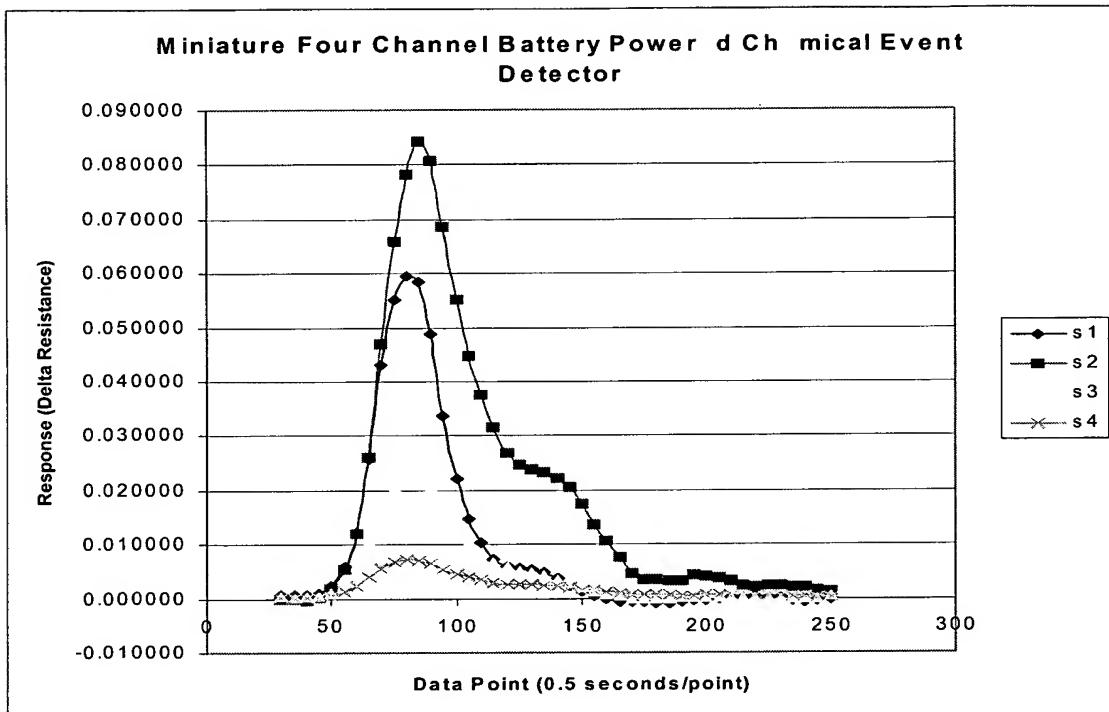
FIG. 4. Typical response curve when a four-channel chemical-event detector is exposed to a transient chemical response.
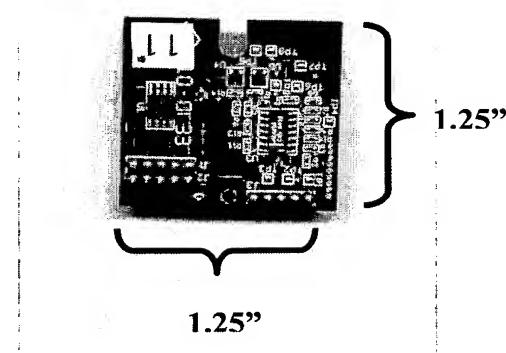

**FIG. 5**. Four-channel chemical-event detector.
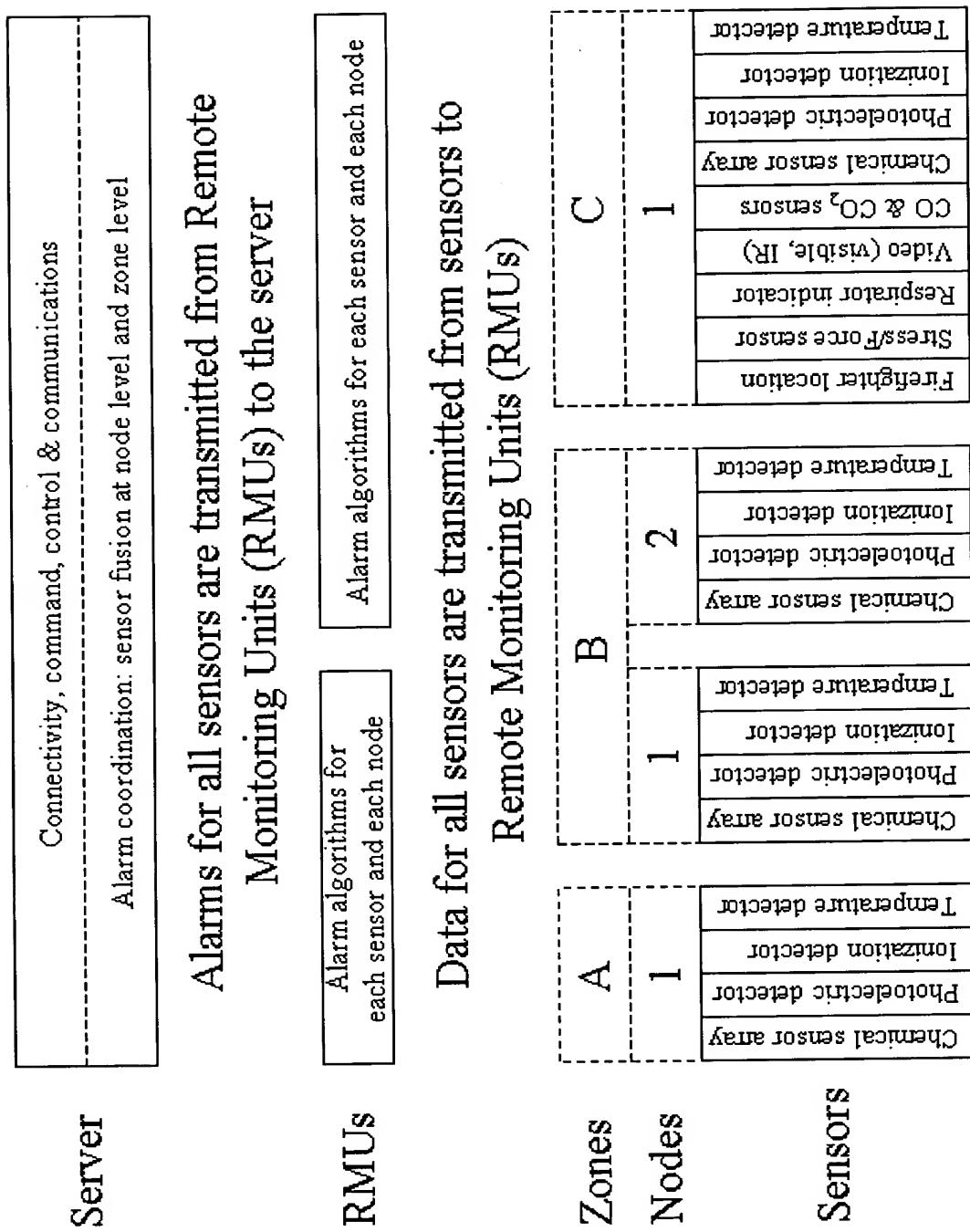
FIG. 6. System architecture for fire detection system. Nodes are defined as a collection of sensors/detectors at a single physical location. Zones are defined by physical relationships between nodes. This multi-level architecture for data analysis makes the system both flexible and scalable.
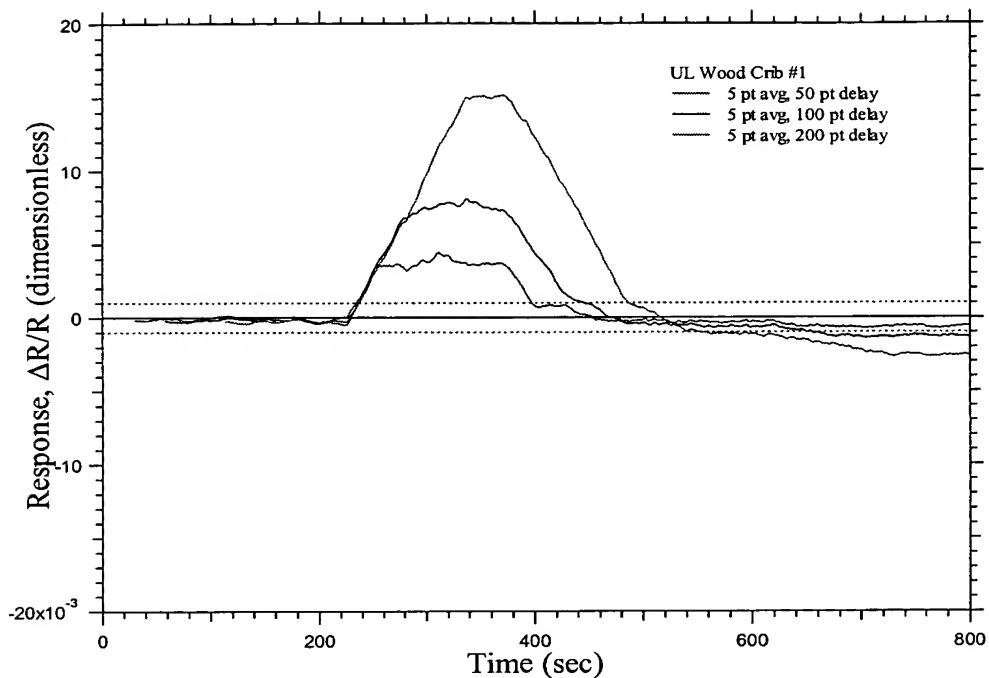
FIG. 7. Response as a function of time for the UL Wood Crib #1 fire. There is a significant difference in the magnitude of the response for different size buffers.
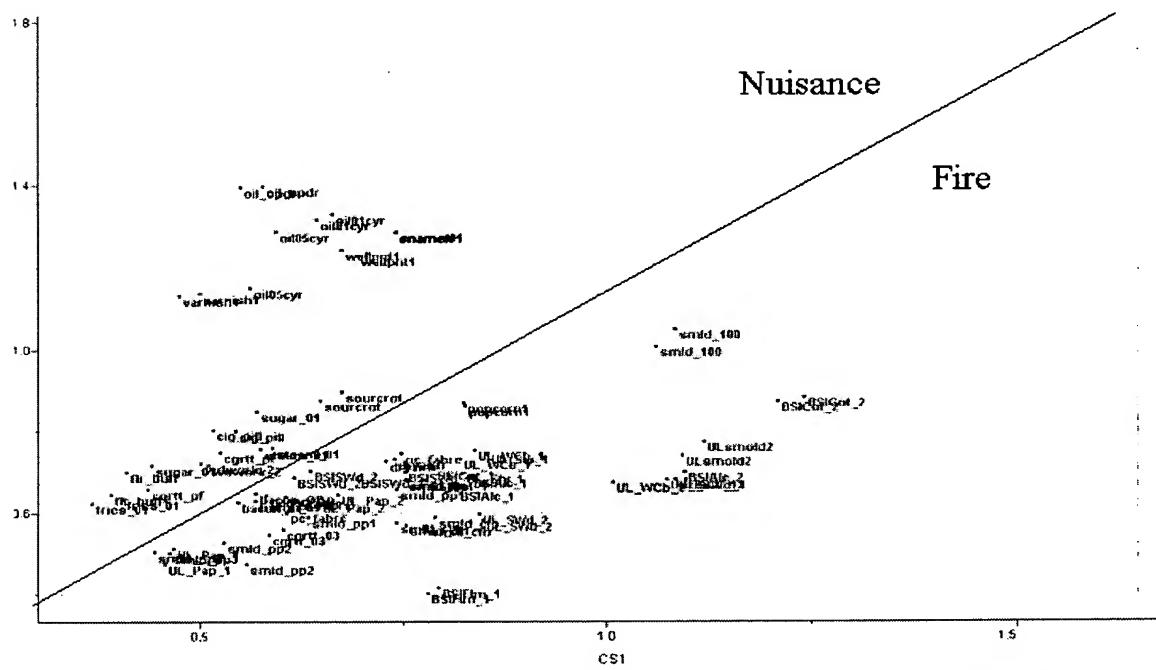

FIG. 8. The results for a Soft Independent Modeling of Class Analogy (SIMCA) model for fire (red) and nuisance tests (blue) that exceed the positive detection threshold. The line separating these two regions was drawn to minimize the number of false negatives---the case where the actual event is a fire but no alarm is sounded.

End of Service Life Indicator (ESLI)
for chemical filters for Military,
Homeland Security & Industry:

Forward-deployed personnel
Facility & weapons inspection
Embassy/Civilian personnel
First responders (FD, PD, EMS)
Hazardous chemical handling

sensors
~2 mm
(in filter bed)

Alarm !
breakthrough
user ID
date & time

Cyrano
ESLI annunciator
or wireless TX/RX
(durable inside mask)

FIG. 9

Distributed Sensor Networks and
Notification

eTeam

Airport Personnel

CW agent
detected

Alarms &
Shut-down
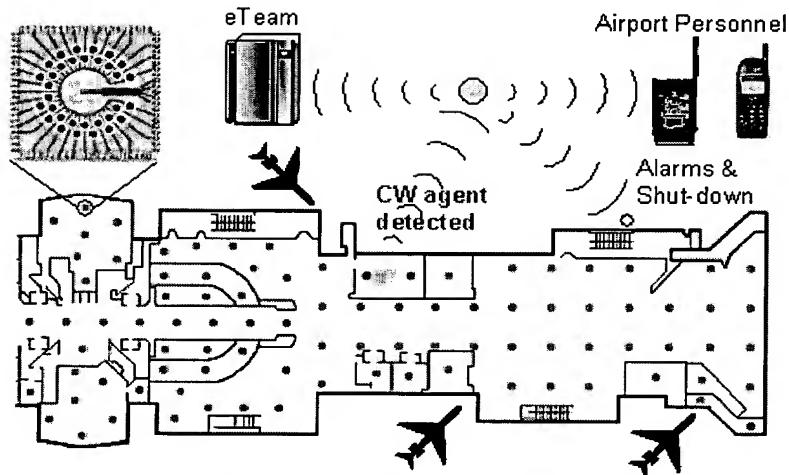
FIG. 10: Remote detection and notification in airport terminals.
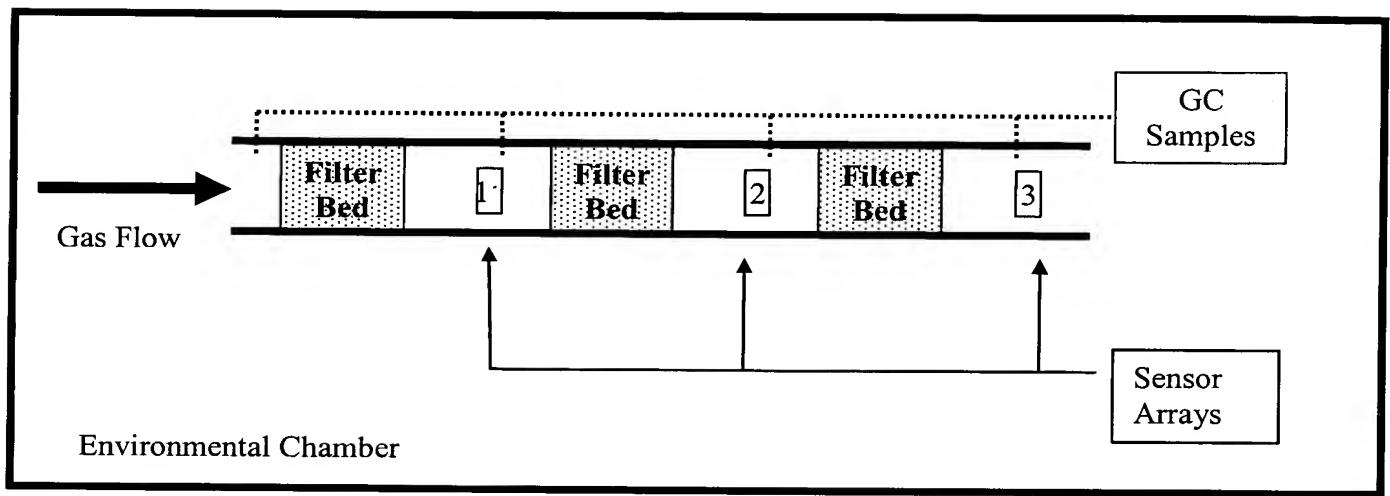
FIG. 11: Schematic Representation of Residual Life Indicator Fixture

Personal Protection Mask

Filter with embedded sensors

Residual Life LED's and buzzer

Gas Inlet

To Breathing Machine

Test Chamber
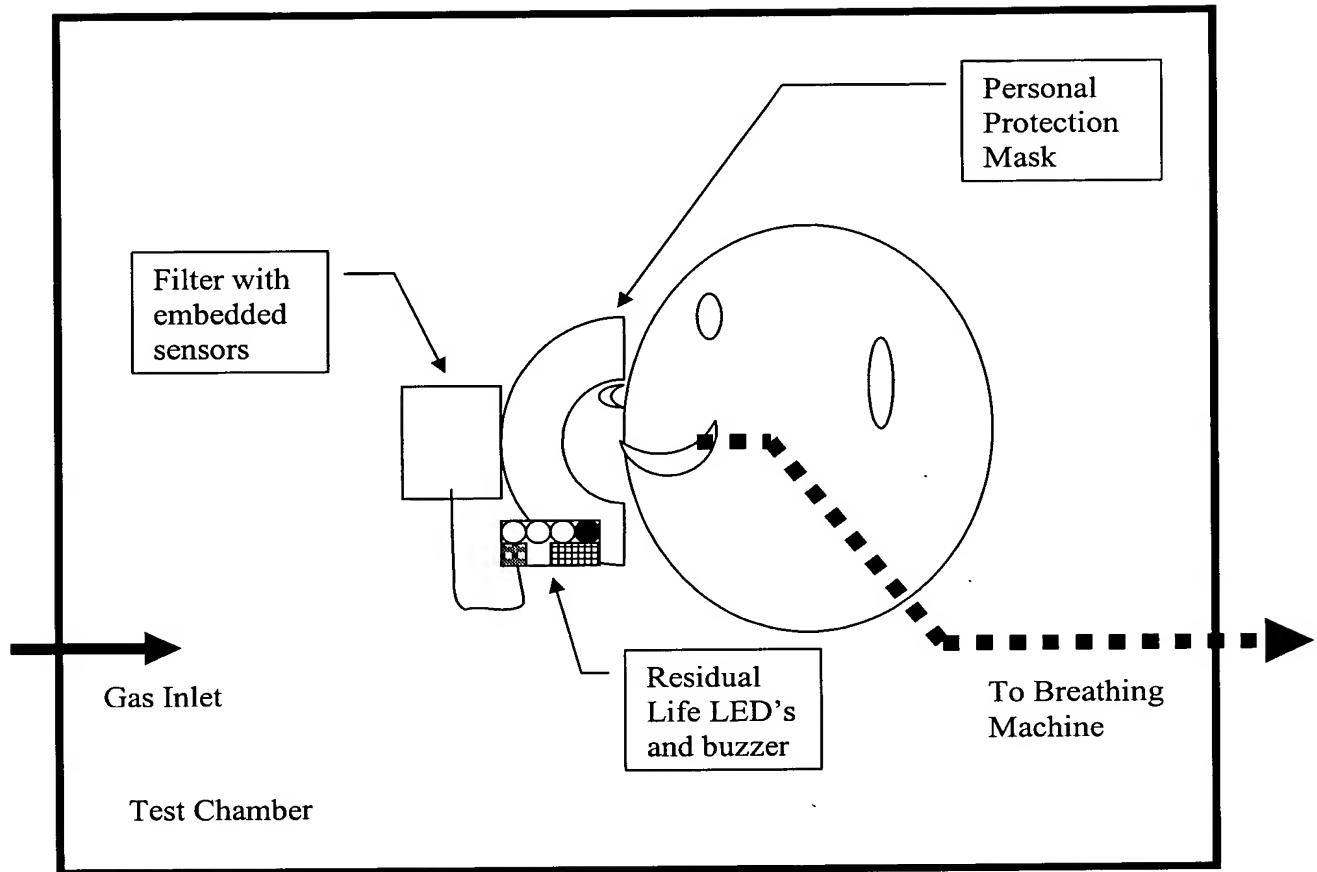
FIG. 12

FIG. 13

FIG. 14

FIG. 15

FIG. 16

FIG. 17

Vref

adaption node

Vcc

I const
(short time)

$\Delta V = \Delta R/R \cdot Vref$

Sensor

- Set Vs = Vref
- I=const = Vref/R
- R→ R+ ΔR
- $\Delta V = I(R+ \Delta R) - Vref$
- $\Delta V = Vref(1+ \Delta R/R) - Vref$
- $\Delta V = \Delta R/R \cdot Vref$
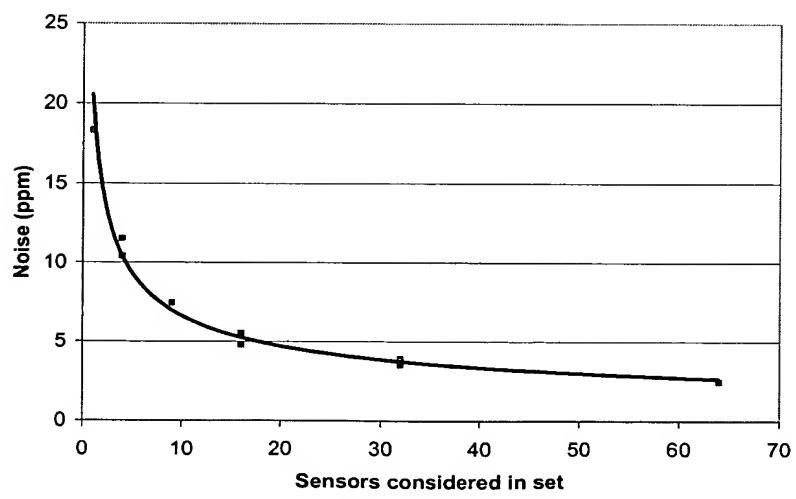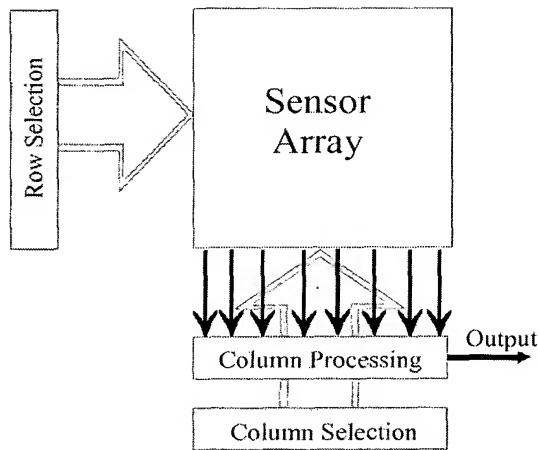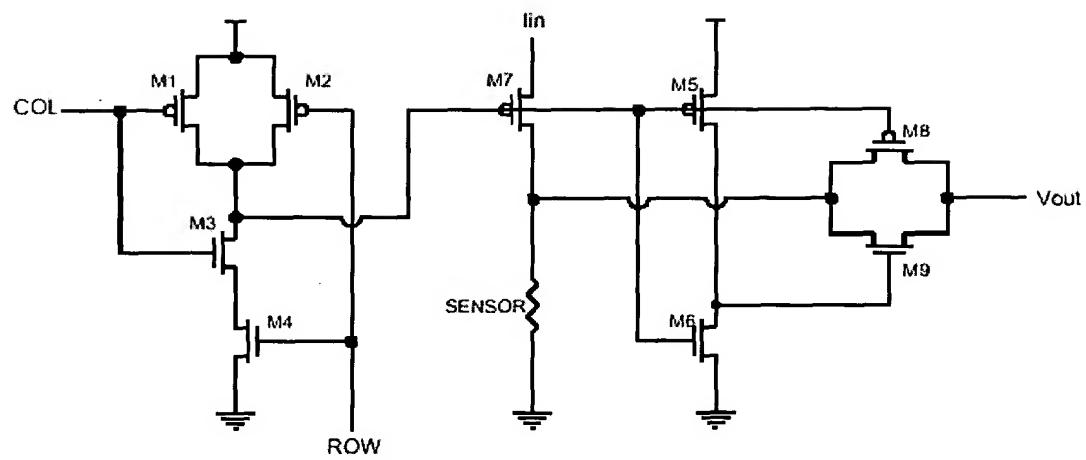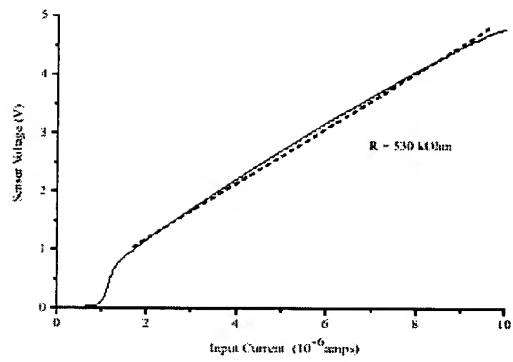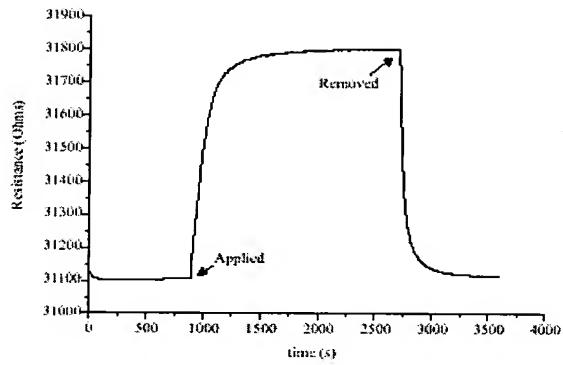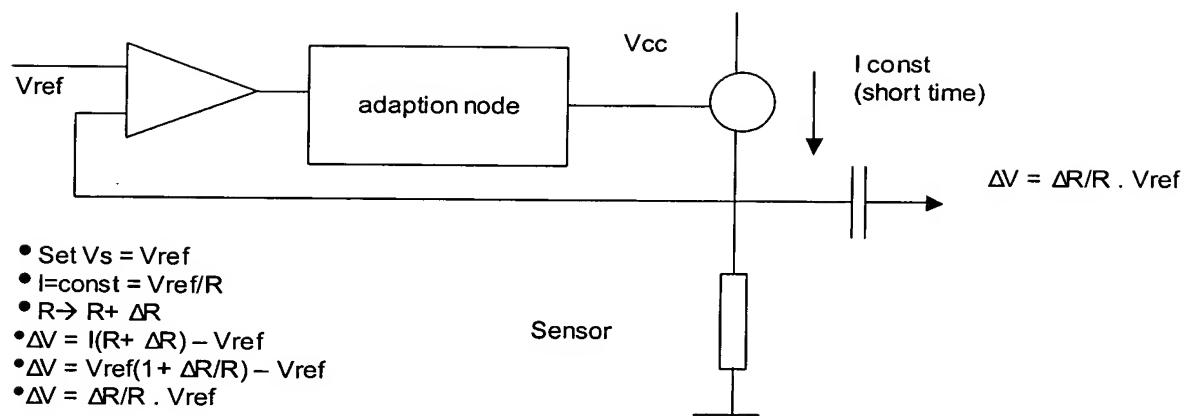
FIG. 18

Sample #	Treatment	Solvents	Particle Size nm
6537-57b	Poly(isobutylene) on BP700	Isopar G	150
8847-9a	Polypropylene glycol on BP700	Xylene	180
6537-40	Poly(acrylic ester) on BP700	Ethanol	210
6537-51	Poly(acrylic acid) on BP700	water	210

FIG. 19
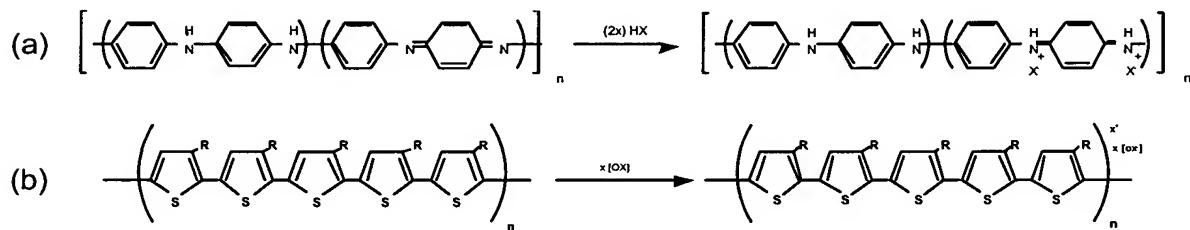
FIG. 20. (a) Chemical structure of polyaniline in its insulating state and its conducting state (following protonation by an acid, HX); (b) chemical structure of poly(3-substituted-thiophene) where R = H, or alkyl, [OX] = oxidizing agent, in its insulating state and its conducting state (following oxidative "doping").
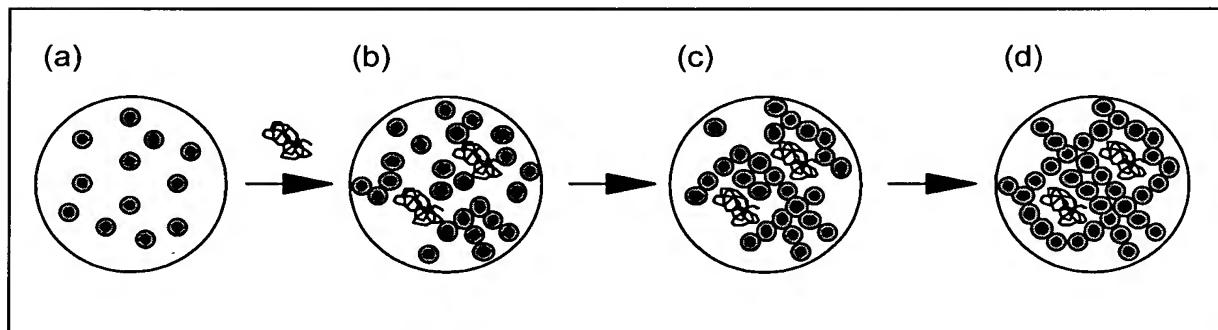
FIG. 21. Schematic diagram of the sol-gel encapsulation of indicator biomolecules. (a) Formation of sol particles during initial hydrolysis and polycondensation. (b) Addition of indicator biomolecule to the sol. (c) The growing silicate network begins to trap the biomolecules. (d) The indicator biomolecules are immobilized in the gel.

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         ┌─────────────┐
         │   SLEEP     │◄──────────────────┐
         └─────────────┘                   │
                │                          │
                ▼                          │
         ┌─────────────┐                   │
         │   AWAKE     │                   │
         └─────────────┘                   │
                │                          │
                ▼                          │
         ┌─────────────┐                   │
         │   SCAN      │                   │
         └─────────────┘                   │
                │                          │
                ▼                          │
             ╱╲                            │
           ╱    ╲                          │
         ╱ EVENT  ╲                        │
        ╱ DETECTED ╲───────────────────── N
         ╲    ?   ╱
           ╲    ╱
             ╲╱
                │
                Y
                │
                ▼
     ┌──────────────────────┐
     │ EVENT                │
     │ IDENTIFICATION       │
     │ PROCESS(ES)          │
     └──────────────────────┘
                │
                ▼
     ┌──────────────────────┐
     │  DISPLAY,            │
     │  ALARM,             │
     │  OUTPUT SIGNAL       │
     └──────────────────────┘
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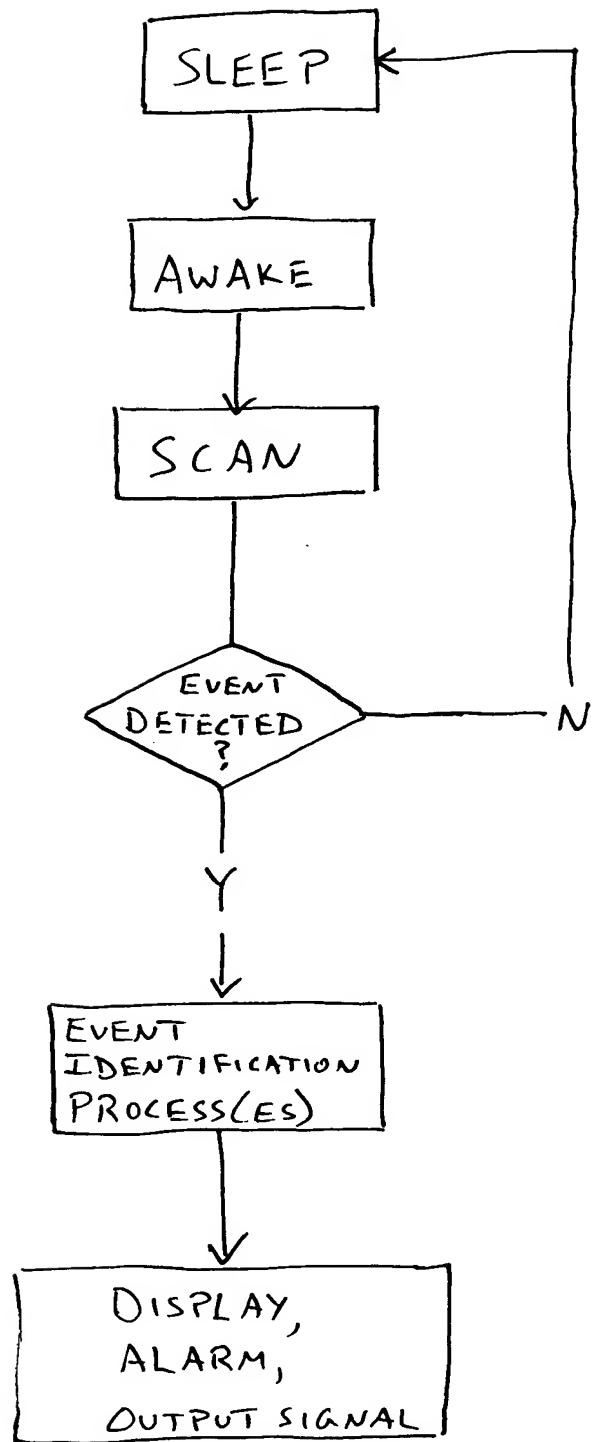
FIG. 22
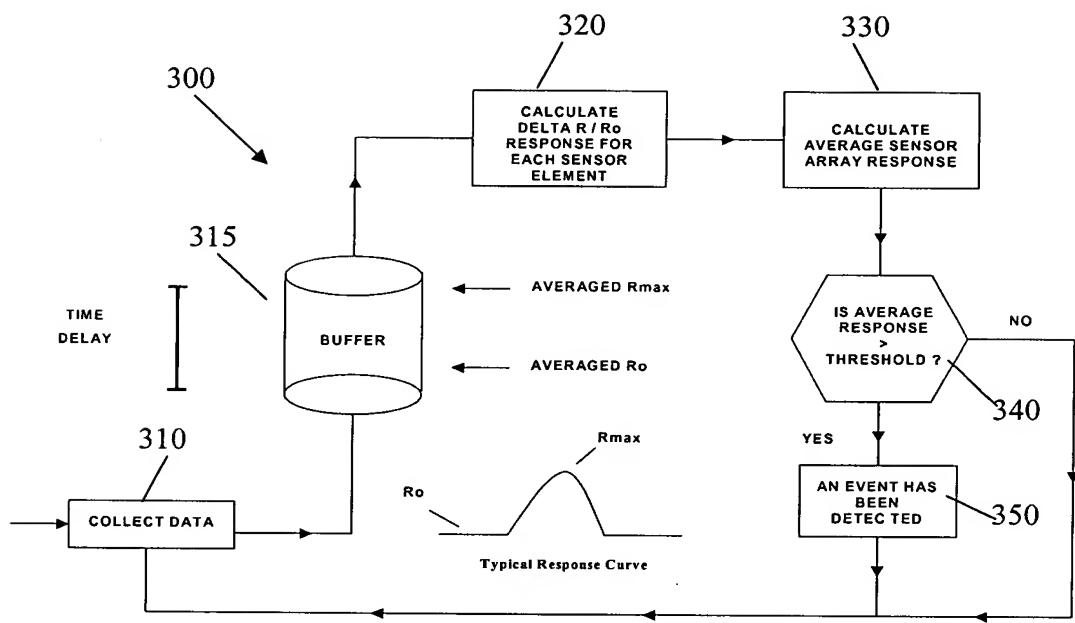
FIG. 23: BLOCK DIAGRAM OF FIRE DETECTION ALGORITHM & TYPICAL SENSOR RESPONSE CURVE